

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants : Stephen V.R. Hellriegel et al.
Application No. : 10/012,210
Filed : November 5, 2001
For : ELECTRICAL CONNECTOR WITH STRAIN RELIEF
STRUCTURE

Examiner : Tuan T. Dinh
Art Unit : 2841
Docket No. : 901115.435
Date : November 13, 2006

Mail Stop Appeal Brief - Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

APPELLANT'S BRIEF

Commissioner for Patents:

This brief is in furtherance of the Notice of Appeal, filed in this case on April 12, 2005. The fees required under Section 1.17(c), and any required request for extension of time for filing this brief and fees therefore, are dealt with in the accompanying transmittal letter.

I. REAL PARTY IN INTEREST

The real party in interest is Cray, Inc., which is the current name of the assignee of the present invention.

II. RELATED APPEALS AND INTERFERENCES

There are no other appeals or interferences which directly affect or will be directly affected by or have a bearing on the Board's decision in this appeal.

III. STATUS OF CLAIMS

Claims 1-21 are currently pending and active in the application. All pending claims are rejected, and all pending claims are being appealed.

IV. STATUS OF AMENDMENTS

The Final Rejection was mailed January 12, 2005. In response to this Final Rejection, a Notice of Appeal was filed on April 12, 2005. An amendment after final is submitted herewith, in which a new Figure 12 and accompanying text are added in response to an objection by the Examiner in the Final Office Action, which the Examiner indicated would not be held in abeyance. Entry thereof is earnestly requested. In arguing the allowability of the pending claims, applicant does not rely on the material added by the attached amendment. Accordingly, in the event that the amendment is not entered prior to consideration of this appeal, applicant respectfully requests that further action regarding the necessity of a new figure be held in abeyance until after the decision of the Board regarding the allowability of the claims.

V. SUMMARY OF CLAIMED SUBJECT MATTER

The summary that follows is intended to provide sufficient information to enable the claims and support the following arguments that follow. References to the specification will indicate page and line numbers separated by a colon, e.g., 4:21, indicating page four, line 21 of the specification. The figures provided in this section are from the specification, and bear the same figure numbers as found in the specification. The scopes of the respective claims are not to be construed by this summary, which is only for the purpose of briefly explaining the subject matter in question.

One type of connector used in high performance computers is a flexible substrate having a plurality of small metal contact pads on the surface. Such connectors may be used, for

example, to electrically couple one circuit board to another. The flexible substrate of the connector is aligned with corresponding contact pads on a circuit board and a controlled pressure is applied to bring the contact pads of the substrate into firm electrical contact with those of the circuit board. Connectors of this type often have contact densities exceeding 300 or 400 contacts per square inch. As contact densities increase on such connectors an ever larger percentage of the surface area of the flexible substrate is occupied by metal contact pads. As density increases, the flexibility of the substrate is reduced by the higher and higher percentage of surface area that is occupied by the inflexible metal structures of the contact pads. At the same time, the distance between contacts becomes smaller (3:20-4:21).

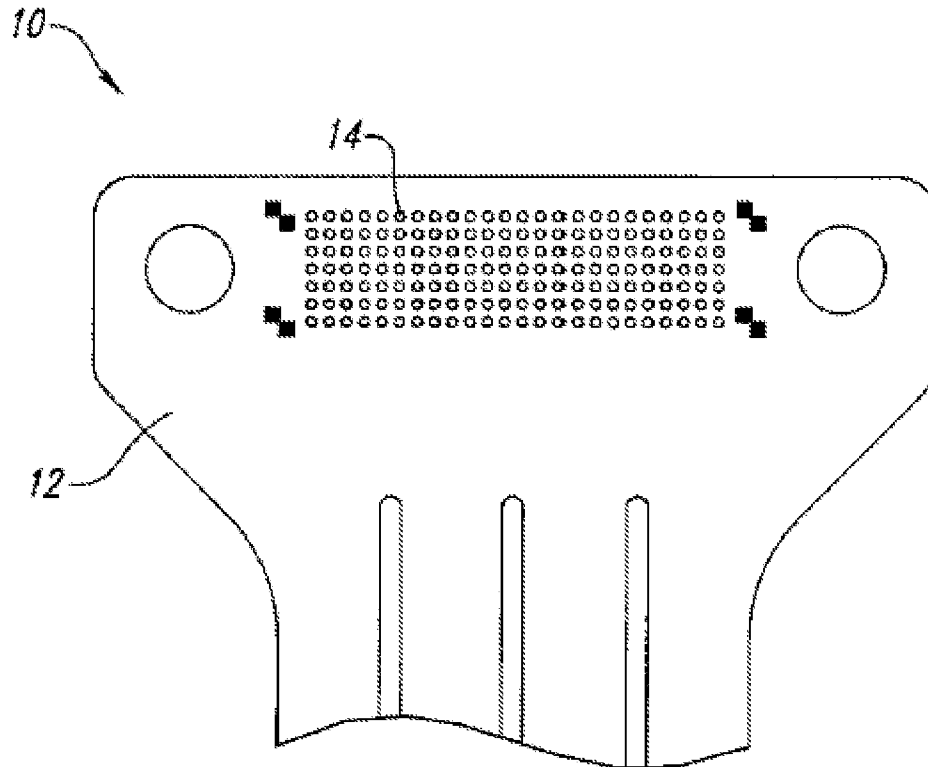


Fig. 1

Figure 1 illustrates a connector 10 of the type described, on which the contact pads 14 are arranged with a density of about 400 pads per square inch.

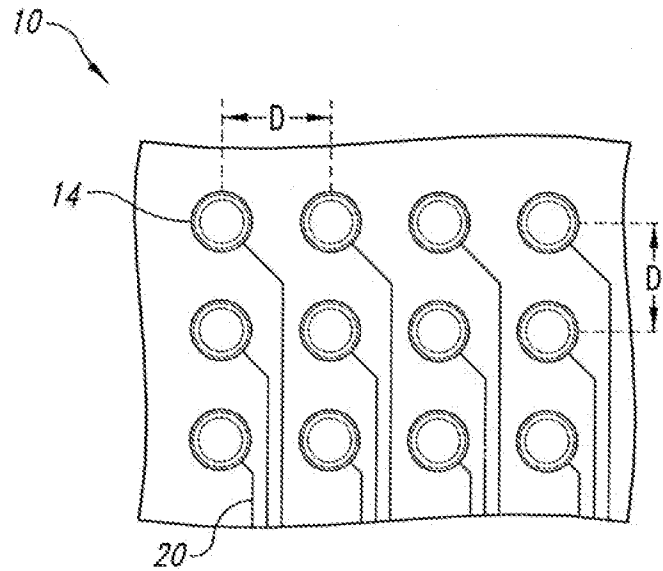
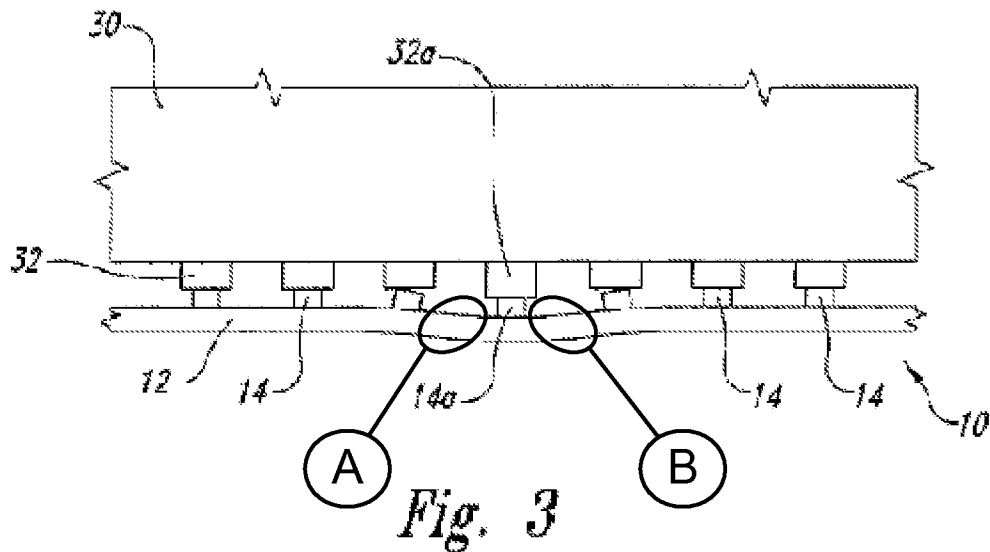


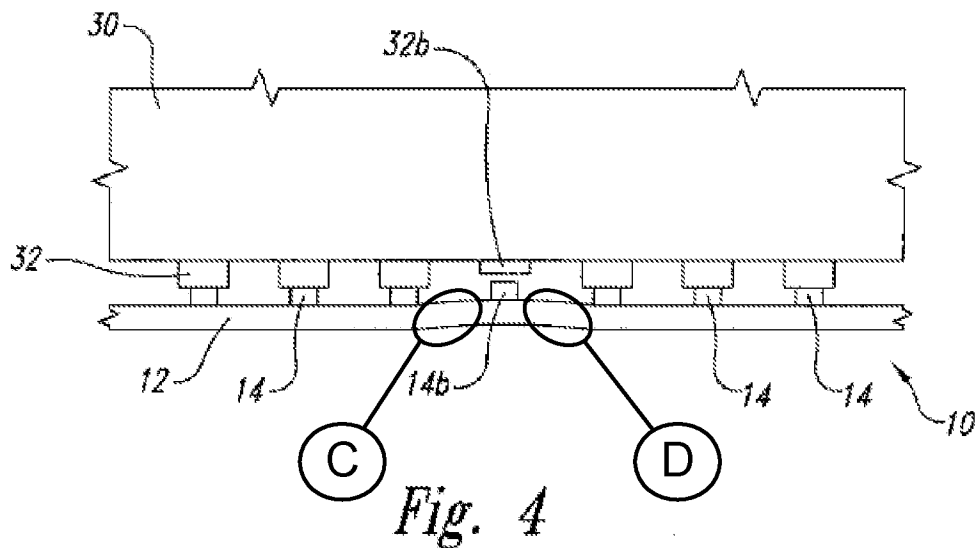
Fig. 2

Figure 2 shows a detail of the connector of Figure 1 in which, in the example shown, the distance D is about .05". Also shown are the electrical traces 20 that serve to connect the contact pads 14 of the illustrated connector with those of another connector.



Figures 3 and 4 illustrate some of the difficulties that can occur when using high density connectors such as that illustrated in Figure 1.

Figure 3 shows a flexible connector 12 having contact pads 14 thereon in alignment with contact pads 32 of a circuit board 30, such that contact pads on each are brought into electrical connection. The figures and various features are greatly enlarged here for illustration purposes. Since the contacts are very small, even minor variations in the height of either will affect the contact performance. If one of the contact pads 32a of the circuit board 30 is slightly taller than those surrounding it, the contact pad 14a on the flexible connector contacts this high pad 32a first and pushes back on the flexible connector 12, such that contact pads adjacent to the contact pad 14a are unable to make firm contact with their corresponding contact pads of the circuit board 30. The substrate 12 in zones A and B becomes tight and pulls the adjacent pads out of alignment. With very tight tolerances and close spacing between pads, even a small difference in height can cause a problem. In the case shown, where the contacting surface is reduced to a very small area, undesirable resistance is introduced in the connections between those contact pads (5:1-11).



Referring to Figure 4, it may be seen that the contact pad 32b of the circuit board 30 is slightly shorter than those contact pads 32 surrounding it. As a result, the flexible connector 12 bridges across that contact pad 32b, and the contact pad 14b of the flexible connector 12 is unable to make electrical contact with the contact pad 32b. The substrate 12, though nominally flexible, is not sufficiently flexible to compensate for the height difference between the circuit board contact pads 32 and 32a, so that it holds pad 14b back and prevents it from touching, even with high pressure applied. Consequently, no electrical connection is formed between the contact pad 14b of the flexible connector 12 and the contact pad 32b of the circuit board 30.

Failure of the connection of one or more contact pads, from among thousands of such connections in a complex system, may cause the entire system to shut down. Additionally, troubleshooting such a failure can be extremely difficult. Two approaches used in the prior art are: 1) make the contacts more exactly the same height; and 2) apply greater force to the connector to force compliance. The first solution, making more uniform contact heights, is workable, but can be very expensive since precise control of metal buildup during plating is difficult and tight tolerances are hard to achieve, and so, quite costly. The second solution, use greater force to cause the connector to flex sufficiently to make connection, can damage the connector by breaking traces, deforming the contact pads, or delaminating the connector (5:12-25).

The inventors realized that a better solution is more flexibility, rather than more uniform heights or more pressure. By making the connector substrate more flexible in the region of the contact pads, it can bend between contact pads to more easily conform to the circuit board variations from one contact pad to another. At the same time, the remainder of the connector is maintained at a lower degree of flexibility to protect the fragile electrical traces (5:26-6:13).

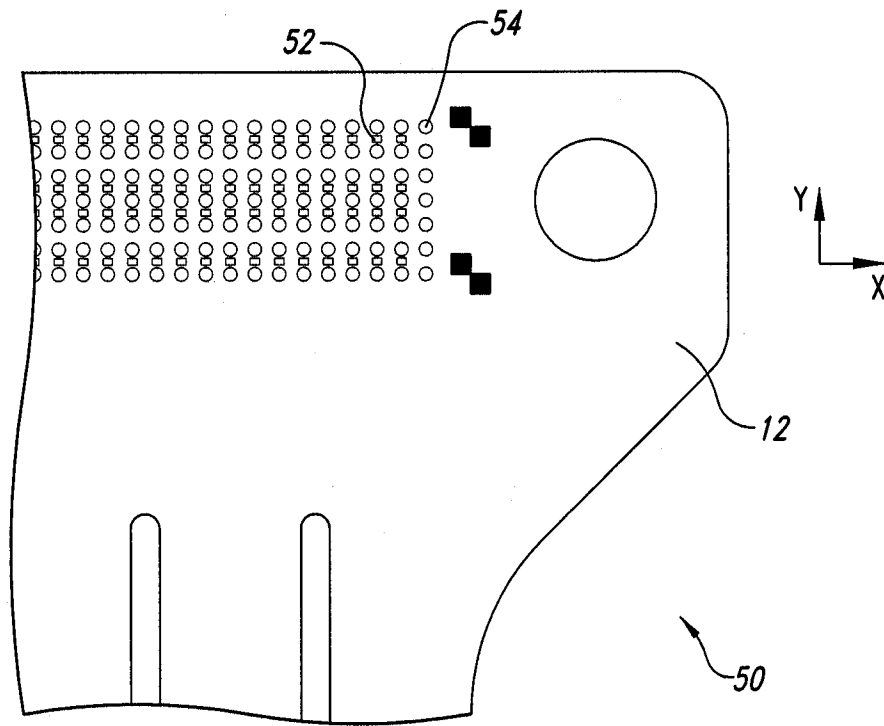


Fig. 5

Embodiments of the present invention are directed to structures and methods for locally increasing the flexibility of flexible connector substrate 12. According to the embodiment of Figure 5, the flexibility of the substrate 12 is increased by providing strain relief structures 52 in the regions A and B, and C and D, to permit the substrate 12 to flex more at these locations. These strain relief structures 52 are selectively positioned between closely adjacent contact pads 54 to enhance the local flexibility of the connector 12 for the purpose of overcoming the problems described with reference to Figures 3 and 4 (6:4-26).

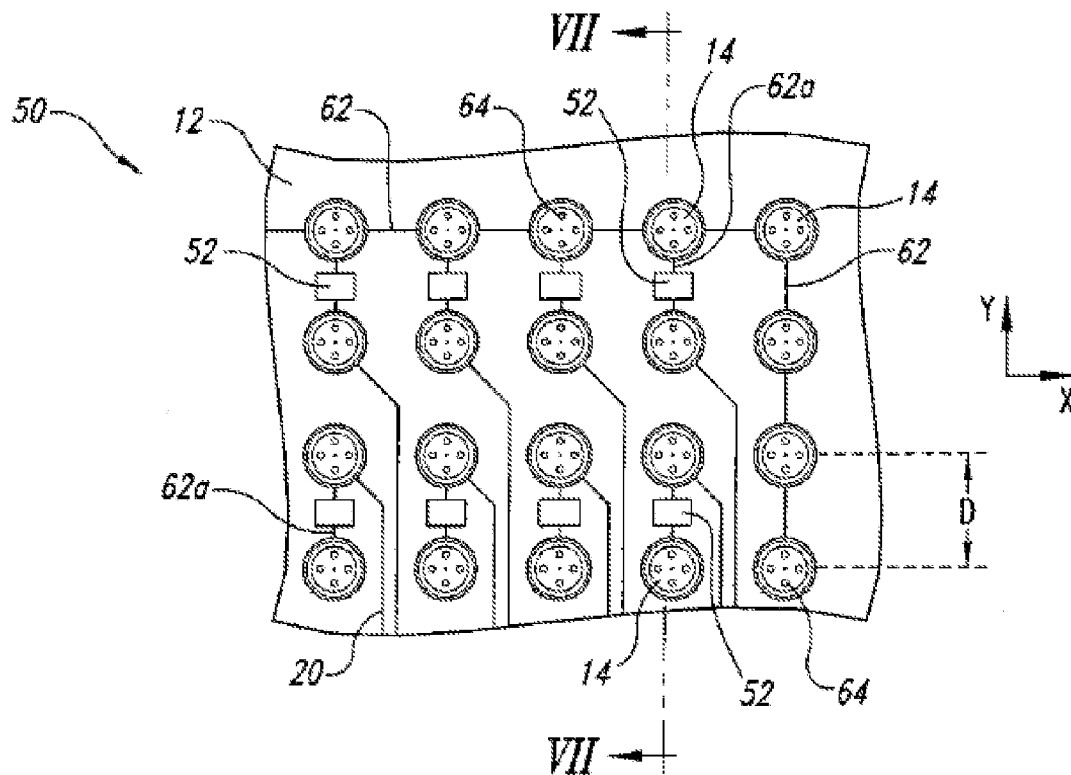


Fig. 6

Figure 6 of the present application, reproduced above, shows one embodiment. It may be seen that each of the strain relief structures 12 is positioned to electrically interrupt the traces 62a formed between contact pads 54. This is advantageous for manufacturing, since it allows contiguous contact pads 54 to be commonly connected during the plating processes, but electrically separated, by the formation of apertures of the strain relief structures during a later step, which physically and electrically interrupts the connecting traces, in order to electrically isolate the respective contact pads from each other (6:23-26, 8:20-9:15).

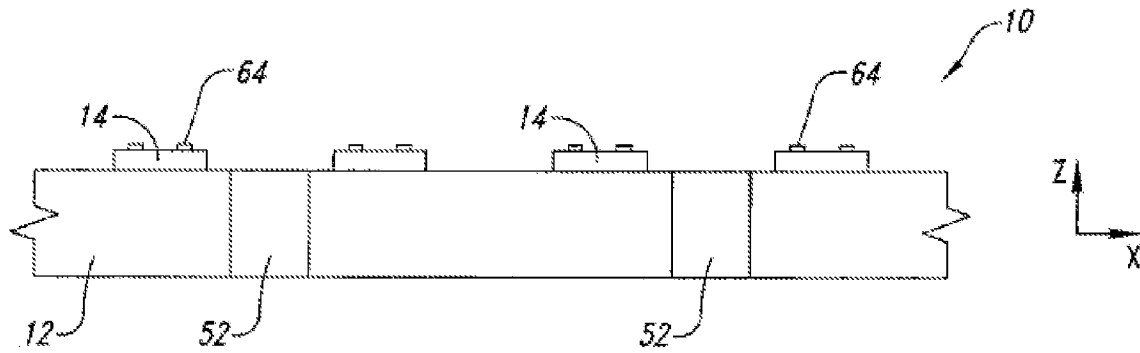


Fig. 7

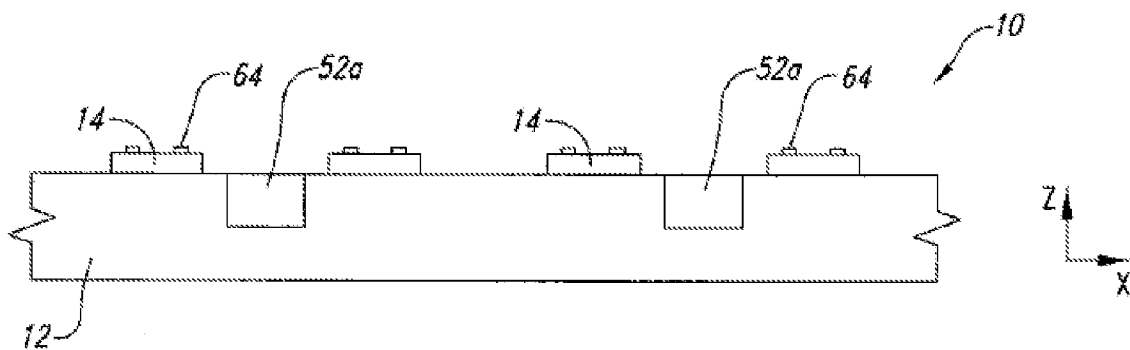


Fig. 8

Figure 7 illustrates an embodiment in which apertures 52 are formed traversing the entire thickness of the flexible connector 12. Figure 8 illustrates another embodiment, in which blind apertures 52a are formed in the flexible substrate 12. The apertures 52a do not pass entirely through the thickness of the flexible substrate 12, but penetrate to a selected depth, the depth being selected according to the amount of added flexibility desired. Because there is less material, the connector 12 is more flexible adjacent to locations 52. It is counter-intuitive that forming apertures between the contact pads will improve the electrical connections, but that is the result of this invention (7:11-24).

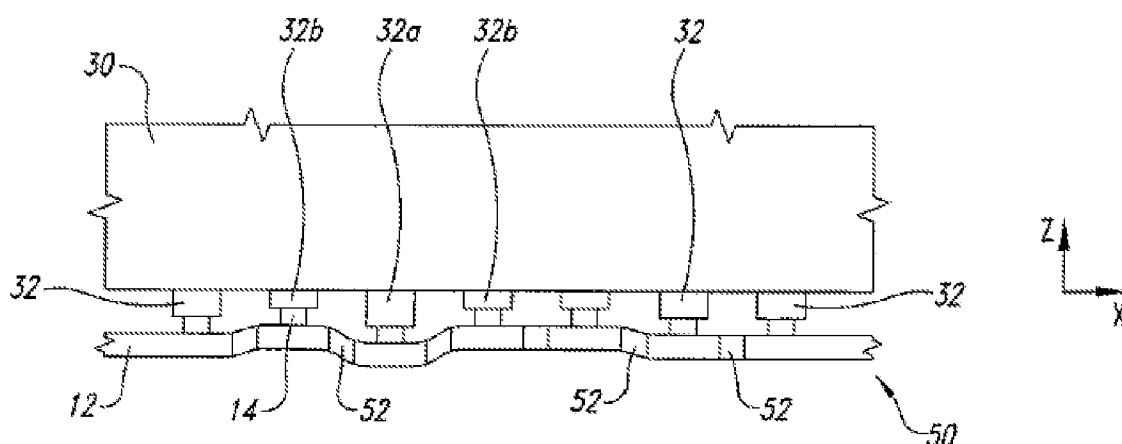


Fig. 9

Figure 9 illustrates a flexible connector 12 having contact pads 14 in contact with contact pads 32 of a circuit board 30, in which strain relief structures 52 provide localized strain relief, allowing the flexible connector 12 to accommodate variations in length of the contact pads 32a and 32b of the circuit board 30. Variations in size of the contact pads 14 of the flexible connector are also compensated for in a similar manner.

Not only do the strain relief structures of the various embodiments of the invention improve the dependability of the connections, but, because they allow the flexible connector to tolerate variations in contact heights, manufacturing tolerances can be relaxed, with respect to planarity of contact surfaces on both the connector and the circuit board. This means that fewer parts are rejected and production costs are reduced. At the same time, the flexible substrate as a whole can remain at a higher degree of stiffness as may be required to protect electrical traces, etc. (8:1-19).

In particular, claim 14 includes a means plus function element: “means for increasing flexibility of the substrate in the contact region.” One example of such means is the strain relief structures 52 of Figure 9, as described above. Support for this element may be found, with reference to Figure 9, at page 8, lines 10-18.

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

Claims 1-8 and 14-17 are rejected under 35 U.S.C. § 112, first paragraph as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventors, at the time the application was filed, had possession of the claimed invention.

Claims 1, 2, 4, and 6-17 stand rejected under 35 U.S.C. § 102(e) as being anticipated by Markovick et al. (US 6,291,776, hereafter “Markovick”).

Claims 3 and 5 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Markovick in view of Furnival (US 3,977,074).

VII. ARGUMENT: ART OF RECORD DOES NOT ESTABLISH *PRIMA FACIE* CASE OF UNPATENTABILITY

Rejections Under 35 U.S.C. § 112:

Claims 1-8 and 14-17 were rejected under 35 U.S.C. § 112, first paragraph, as containing subject matter that is not appropriately disclosed in the specification. In rejecting these claims, the Examiner states, “the specification *is not disclosed* a new matter of the limitations of ‘a device configured to electrically connect first and **second circuit boards**, recited in claims 1 and 14’.” (Emphasis and underlining in original.)

Applicant finds this statement confusing, but believes that the Examiner’s position is that the specification, as originally filed, did not disclose connectors for electrically connecting first and second circuit boards as claimed.

In response, applicant points to the specification, page, 4, line 10, where it states, “Flexible connectors are frequently employed to connect a circuit board to another circuit board or a peripheral device.” There is no question that the concept of interconnecting circuit boards is introduced in the present application. Additionally, the application states, at page 3, line 23, “Electrical traces 20, shown in Figure 2, in electrical contact with the contact pads, provide electrical coupling with other circuits or connectors....” Finally, Figure 9 shows a flexible

connector 50 coupled to a circuit board 30, as described in the specification beginning at page 8, line 1.

Connectors used to interconnect circuit boards are ubiquitous in the industry. Virtually every computer in use today employs some type of connector for this purpose. The idea that one of ordinary skill would not recognize that the inventors envisioned the connectors disclosed as being applicable to such an application is extremely farfetched. Given the content of the disclosure, including the passages cited herein, one of ordinary skill in the art would have no doubt that the claimed subject matter was in the possession of the inventors as of the filing date of the present application.

Claim 1-8

Claim 1 recites, in part, “A device configured to electrically connect first and second circuit boards, comprising:...a plurality of contact pads on a first surface of the substrate configured to make electrical contact with contact pads of the first circuit board...” Reference to Figure 9 and the accompanying text beginning at page 8, line 14, clearly discloses an embodiment of the subject matter of claim 1, and on which the recited limitation reads. The first and second circuit boards of the preamble are not recited elements of the claim, but only provide the intended use. In particular, the plurality of contact pads is configured to make electrical contact with...the first circuit board. With respect to the second circuit board, there is no element reciting a particular structure for such a connection, and applicants consider the intended use to be read broadly, and further consider that one of ordinary skill in the art is capable of implementing any number of connectors or attachments to many types of circuit boards, peripheral devices, circuits, etc.

Claims 14-17

The preamble of claim 14 states, “A flexible connector for placing first and second circuit boards in electrical contact...” The preamble provides a statement of purpose of use, but does not comprise a limitation to the claims. Accordingly, there is no requirement that these features

be disclosed in the specification. Nevertheless, ample disclosure is provided in the passages and figures cited above.

Conclusion of Rejections under 35 U.S.C. § 112

It would be clear to one of ordinary skill in the art that the inventors had possession of the claimed invention at the time of the filing of the present application. Claims 1-8 and 14-17 are clearly allowable in view of 35 U.S.C. §112, first paragraph.

Rejections Under 35 U.S.C. § 102

Claims 1, 2, 4, and 6-20 were rejected under 35 U.S.C. § 102(e) as being anticipated by Markovick.

“A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference.” *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631, 2 U.S.P.Q.2d 1051, 1053 (Fed. Cir. 1987). “The identical invention must be shown in as complete detail as is contained in the ... claim.” *Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 1236, 9 U.S.P.Q.2d 1913, 1920 (Fed. Cir. 1989). The elements must be arranged as required by the claim, but this is not an *ipsissimis verbis* test, *i.e.*, identity of terminology is not required. *In re Bond*, 910 F.2d 831, 15 U.S.P.Q.2d 1566 (Fed. Cir. 1990).

The Examiner has failed to present a *prima facie* case of anticipation of claims 1, 2, 4, and 6-17. The Examiner erred in asserting that Markovick teaches or enables each of the claimed elements, either expressly or inherently, of the invention as interpreted by one of ordinary skill in the art.

Claims 1, 2, and 6

Claim 1 recites, *inter alia*, “a *flexible* substrate; a plurality of contact pads on a first surface of the substrate configured to make electrical contact with contact pads of the first *circuit board*; and a *strain relief structure*, positioned between two of the plurality of contact pads” (emphasis added). Markovick fails to teach at least the cited elements as recited in claim 1, as will now be shown.

At column 1, line 5, Markovick states, “The present invention relates to a chip carrier...” Markovick further states, “it is an object of the present invention to provide a chip carrier...” (column 3, lines 16 and 17), and “ a further object of the present invention resides in the provision of an organic laminate chip carrier...” (column 3, lines 24 and 25).

As is well known in the art, a chip carrier is a substrate to which a microchip, such as a CPU, for example, is mounted, frequently by solder reflow of a ball grid array (BGA). This process includes, first, the formation of tiny solder balls on contact surfaces formed on a lower face of an encapsulated microchip. The microchip is positioned over the chip carrier such that the solder balls are in contact with respective pads of the chip carrier. The chip and carrier are then heated to a temperature sufficient to melt the solder balls, each of which flows out to form a mechanical and electrically conductive joint between the contact surface of the chip carrier, on which it was originally formed, and the respective pad of the chip carrier. This heating step is what Markovick refers to as the *solder reflow* step. Because this procedure is extremely well known in the art, Markovick does not discuss it in detail, but makes reference to it in discussing the problem addressed, i.e., the distortion and damage that can occur due to thermal mismatch of the organic chip carrier substrate and the metal plating that comprises the pads to which the chip is soldered. See, in particular, the text of column 1, lines 5-35.

The chip carrier is then connected to a circuit board or other electronic device through any of various means, such as via pins, or a separate connector. Markovick is silent as to how the chip carrier of its disclosure is to be so connected, being directed solely to the mounting of a chip to the chip carrier. The ball grid array (BGA) pads 12 cited by the Examiner as being analogous to the contact pads of claim 1, are configured to receive the ball grid arrays of a chip (see column 4, lines 33-35). There is no contemplation that these pads might be used to make contact with a circuit board, nor could the chip carrier function in its intended purpose with a circuit board occupying the pads. Clearly, Markovick fails to teach any feature configured to make electrical contact with a circuit board.

The Examiner has cited Markovick’s column 4, lines 31 and 32 as teaching the flexible substrate of claim 1. The cited passage states, beginning at line 28:

Referring in detail to the drawings, FIG. 1 generally diagrammatically illustrates a...pattern of...plated through-holes (PTH) 10 relative to pads 12 on a substrate 14, such as an organic laminate chip carrier....

MPEP § 706.02 states, “For anticipation under 35 U.S.C. 102, the reference must teach every aspect of the claimed invention either explicitly or impliedly. Any feature not directly taught must be inherently present.”

The applicant does not recognize any explicit reference to a *flexible* substrate in this or any other passage of Markovick. Furthermore, it is well known in the art that flexing of a chip carrier, at the location of a chip, will cause the chip to separate from the carrier, or will delaminate the layers of the carrier. Thus, flexibility, at least in the region of the carrier disclosed and illustrated by Markovick, is undesirable and possibly catastrophic. Accordingly, flexibility is neither explicitly nor impliedly found in Markovick’s chip carrier.

With respect to the question of inherency, applicants acknowledge that there is, perhaps, no substance on earth that may be considered to be absolutely rigid, or perfectly inflexible, if one has control of the dimensions of an object formed therefrom. Thus, according to this absolute interpretation, because there is nothing in existence that is perfectly rigid, it must also be accepted that there is nothing in existence that is not flexible. Given such a position, the term flexible, in any context, would become redundant. However, in interpreting a term as it is used in a patent claim, such reasoning is not part of the consideration. Rather, one must consider the meaning of a term as understood by one having ordinary skill in the art. Such a one, in considering the organic laminate of Markovich’s device, with respect to its flexibility, would consider many factors, including overall dimensions such as length, width, and thickness, and also including the particular composition of the organic laminate.

It is well known in the art that both rigid and flexible organic laminates are widely used to manufacture substrates. This can be easily demonstrated with reference to the Furnival document (U.S. Patent No. 3,977,074) relied upon by the Examiner in the rejection of other claims in the case. At column 2, line 1, Furnival states, “FIG. 1 shows a printed circuit substrate 10 preferably of the *rigid* variety and utilizing any conventional circuit board material.” (Emphasis added.) Compare this passage with the passage beginning at column 2, line 50, which states, “... the conductors ... are preformed on a separate *flexible* substrate 32 which is bonded to

the substrate 10” (Emphasis added.) It is clear from these passages that those of ordinary skill in the art recognize the existence of both rigid and flexible substrates, and thus, would not consider flexibility to be an inherent property of Markovich’s carrier substrate, absent some explicit indication.

Accordingly, inasmuch as Markovich has provided no information beyond the fact that the chip carrier is organic laminate (see, for example, column 1, line 8, column 2, line 46, column 3, lines 17, 24, and 34, and column 4, line 32), it is not inherent, nor can it be inferred, that Markovich’s chip carrier is flexible.

The Examiner has cited the plated through-holes (PTH) 10 of Markovich as being analogous to the strain relief structure of claim 1. Applicants respectfully traverse this position. Markovich, in fact, teaches that plated through-holes are actually a source of strain and deformation, rather than a strain relief. For example, Markovich states, “the closer the proximity of the plated through-hole to a BGA pad, this considerably increases the thermal deformation of the chip carrier at the location of the pad, adversely affecting product reliability through potential failures of the electrical connections at the pad position as a consequence of warpage of the organic material of the chip carrier.” (Column 1, lines 29-35.) Markovich also states, “During reflow which produces thermal deformation or swelling of the organic laminate carrier . . . the deformation takes primarily place at the location of the plated through-hole and extend[s] radially therefrom . . .” (Column 5, lines 1-5.)

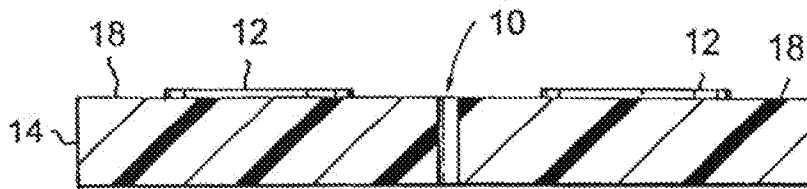


FIG. 4a

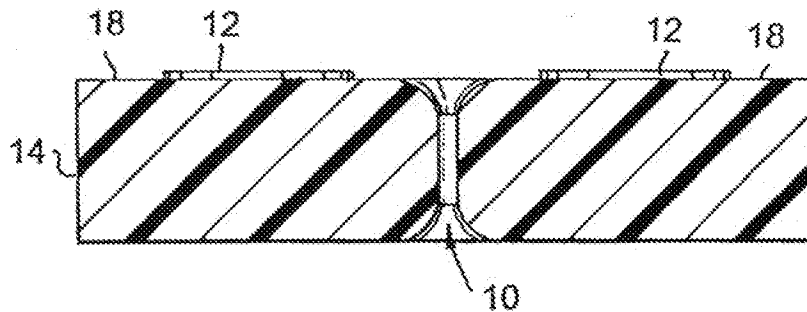


FIG. 4b

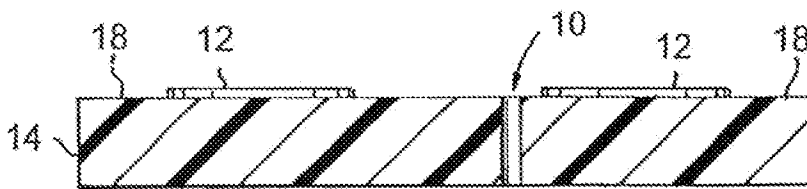


FIG. 5a

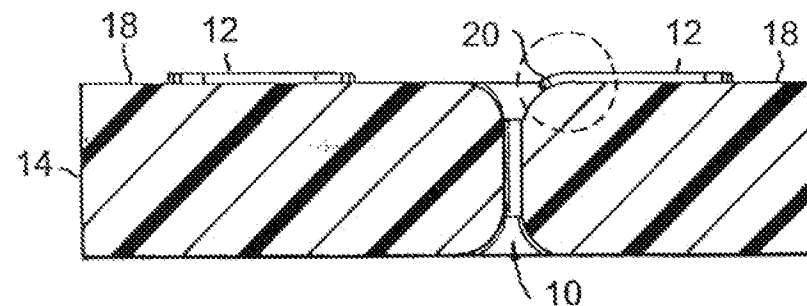


FIG. 5b

Markovick's Figures 4a-5b are shown above. Figure 5b shows the effect of thermal deformation on a chip carrier. It can be seen that the plated through-hole 10 creates a strain in the substrate 14 due to the thermal mismatch caused by the difference in relative coefficients of thermal expansion of the metal of the plated through holes and the organic laminate of the substrate. Heat of a solder reflow, for example, causes the substrate to expand much more than the PTH, resulting in the strain illustrated. The pad 12 can be seen to be distorted by the strain, and possibly damaged. Markovick's solution is illustrated in Figures 4a and 4b. In short, the

strain causing plated through-hole is centered between the pads 12, minimizing the likelihood that the stress of the thermal mismatch will affect either pad. This may be a reasonable response to the problem described by Markovick. However, it is evident that the strain has not been reduced, but simply moved to a safer location. It is also evident that the plated through-hole, cited by the examiner as a strain relief structure is, in fact, the source of the strain. This could be easily demonstrated simply by removing the PTH. without a PTH, there would be no strain, because there would be no thermal mismatch. The PTH's are the source of the strain, and thus cannot also be a strain relief structure.

Finally, Markovick provides Figures 5a and 5b to show the chip carrier of the prior art, and Figures 4a and 4b to illustrate the chip carrier according to the invention (see column 4, line 64-column 5, line 20). Thus, by comparing the figures and noting the differences, the inventive feature can be discerned. The plated through-hole is found in both figures, and thus cannot be regarded as a strain relief structure, for, if it is a strain relief structure in Figure 4b, why is it not also a strain relief structure in Figure 5b. It can also be seen that the strain, i.e., the thermal mismatch, is found in both sets of figures, so Markovick does not actually relieve the strain. The only difference is that Figures 4a and 4b show the PTH as having been moved to a central position between pads to minimize the effect of the strain on the pads.

In view of the above, it is clear that Markovick fails to teach every element of claim 1, and thus fails to anticipate the claim. Claim 1 is thus allowable over Markovick, together with the dependent claims 2-8.

Claim 4

Claim 4 recites the strain relief structure as being “a thinned region of the flexible substrate.” In rejecting claim 4, the Examiner cites the PTH 10 as being the thinned region of claim 4. Presumably, the Examiner is referring to the point in Figure 4b where the PTH causes the surface of the substrate 14 to undergo distortion. However, no thinning has occurred. The material of the substrate is merely temporarily deformed due to the thermal expansion of the substrate during solder reflow. Additionally, as pointed out with reference to Figure 1, the same feature (the distortion) is found in Figure 5b, and is indicated as a source of potential damage

(see column 5, lines 15-20), and so cannot also be a strain relief structure. Finally, the distortion of the substrate that is pictured in Figures 4b and 5b only occurs while a chip is being soldered to the substrate, and thus even if the chip carrier were previously configured to make electrical contact with a circuit board, as recited in base claim 1, the step in the process during which the distortion appears, and during which the “thinning” occurs is the same step in which a chip is soldered over the pads 12, which are therefore inaccessible to make contact with any other device.

Clearly, claim 4 is allowable over Markovick on its own merits.

Claim 7

Claim 7 recites, “a plurality of electrical traces, each of the plurality of electrical traces being in electrical contact with a respective one of the plurality of contact pads and configured to place the respective contact pad in electrical contact with the second circuit board.” Markovich fails to teach the limitation of claim 7. Markovich is directed to a chip carrier, as may be seen, for example, in the text at column 1, lines 5, 13-34, column 2, lines 45-55, and column 3, lines 16-41, to name only a few. One having ordinary skill in the art will recognize the term “chip carrier” as referring to a device configured to receive thereon a microchip die, and to provide an interface between the microchip and a circuit board. Accordingly, Markovich provides no teaching of a plurality of electrical traces configured to place contact pads, themselves configured to make electrical contact with contact pads of a first circuit board, as recited in claim 1, in contact with a second circuit board, as recited in claim 7. Accordingly, claim 7 is allowable on its own merits, apart from its dependence on an allowable claim.

Claim 8

Claim 8 recites, “wherein the strain relief structure is positioned such that it electrically interrupts one of the plurality of electrical traces.” In rejecting claim 8, the Examiner cites Markovich’s plated through-holes as being analogous to the strain relief structure of claim 8. The applicants respectfully traverse this position. Such structures cannot be considered to electrically interrupt electrical traces, since the plated through-holes are electrically conductive,

and are configured to provide electrical interconnection and continuity between different printed circuit layers (see column 1, lines 16-18). Where such plated through-holes are positioned in the path of an electrical trace, electrical continuity is assured by the conductive material of the PTH structure. Accordingly, Markovich does not anticipate the limitation of claim 8, which is allowable over Markovich for reasons beyond its dependence on an allowable base claim.

Claim 9

Claim 9 recites, in part, A first electrical connector, comprising: a flexible substrate; . . .” Markovich fails to teach at least this limitation of claim 9.

Markovich is completely silent with respect to a flexible substrate as recited in claim 9. Accordingly, in order to qualify as a prior art reference under § 102, Markovich must either imply a flexible substrate, or the flexibility must be inherent. There is no figure or passage of Markovich that implies that the substrate is flexible. The Examiner has not pointed to any passage as indicating or implying utility or desirability of such flexibility. In fact, as pointed out above with reference to claim 1, flexing of a chip carrier can damage connections between a chip and the carrier, which applicant believes implies the opposite, a rigid substrate. Furthermore, because both rigid and flexible substrates are well known in the art, flexibility of Markovich’s chip carrier substrate cannot be considered inherent.

Clearly, Markovich does not teach each element of claim 9, which is thus allowable. Dependent claims 18-20 are also therefore allowable as dependent claims thereof.

Claim 18

Claim 18 recites the connector of claim 9, “wherein each of the plurality of apertures is configured to increase flexibility of the substrate.” Markovich’s plated through-holes pointed to as being analogous to the apertures of claim 18 do not make the chip carrier substrate more flexible, but instead would tend to make such a substrate more rigid, inasmuch as the metal plating in the holes and on the surface of the substrate around the holes will stiffen the substrate. Thus there is no such teaching, and claim 18 is allowable on its own merits.

Claims 19 and 20

Claim 19 recites the connector of claim 9, “further comprising an additional electrical trace ... and wherein one of the plurality of apertures is positioned such that the additional electrical trace is electrically interrupted by the one of the plurality of apertures. Though the Examiner cites the plated through-holes as being analogous to the apertures of claim 19, there is no *electrical* interruption occasioned by the PTH’s. On the contrary, the PTH’s actually maintain electrical continuity in the circuit, from one layer to another and around the hole. Markovich fails to teach the limitation of claim 19, which is thus allowable on its own merits, apart from its allowability as depending from an allowable base claim.

Claim 20 includes language similar to claim 19, and is allowable for the same reason.

Claims 10, 12, and 13

Claim 10 recites, in part, “forming, on a first surface of a flexible substrate, a plurality of contact pads...and forming, between two of the plurality of contact pads, a strain relief structure.” Markovich’s inadequacy, both with respect to a teaching of a flexible substrate, as well as a teaching of a strain relief structure has been well established. Markovich is equally inadequate in teaching such limitations with respect to claim 10, which is therefore allowable thereover, together with dependent claims 11-13 and 21.

Claim 11

Claim 11 recites the additional step of “including breaking one of the electrical traces with the forming the strain relief structure step. Markovich does not teach breaking the electrical traces at any time in the process of forming a chip carrier, and thus fails to anticipate the limitation of claim 11. Accordingly, claim 11 is allowable on its own merits.

Claim 14

Claim 14 recites, in part, “a flexible substrate...and means for increasing flexibility of the substrate in the contact region. Markovich fails to teach at least these limitations of claim 14.

For the first part, there is no teaching that Markovich’s substrate is flexible. The Examiner has merely pointed to figures and a passage of Markovich that make reference to a

substrate. The Examiner has offered no explanation as to how this may be considered a teaching of a *flexible* substrate. A chip carrier is certainly not known in the art to be flexible, especially in the portion of the chip carrier where the chip is attached. This is the portion to which Markovich is directed.

For the second part, Markovich offers no teaching that the substrate should be made *more* flexible, nor does it teach how such increased flexibility should be achieved. Clearly, claim 14 is allowable over Markovich, together with dependent claims 15-17.

Claim 15

Claim 15 recites the “connector of claim 14 wherein the means for increasing flexibility comprises a plurality of apertures intercalated with the plurality of contact pads and penetrating the flexible substrate from the first surface to a second surface, opposite the first.” As is well known in the art, plated through-holes such as those taught by Markovich actually increase stiffness. The holes are plated with rigid metal, which makes them less flexible, not more flexible. The metal barrel lining the holes will prevent any flexion that might otherwise occur around or through the hole. The resulting structure is more stiff than the substrate would be with no hole at all. Apparently, the Examiner has assumed that any aperture that passes through a substrate qualifies as a strain relief structure, but clearly, the PTH’s fall into the category of inflexible metal structures. Structures such as these will inherently reduce flexibility of the substrate upon which they are formed. Thus, they cannot be regarded as increasing flexibility, but, on the contrary, will tend to increase stiffness, and will localize distortion at the edges of the metal surfaces during flexing of the substrate. Claim 15 is clearly allowable on its own merits.

Claim 16

Claim 16 recites the “connector of claim 14 wherein the means for increasing flexibility comprises a plurality of blind apertures intercalated with the plurality of contact pads and penetrating the flexible substrate from the first surface to selected depth.” Markovich is completely silent with respect to such a teaching. In rejecting claim 16, the Examiner cites blind apertures 10, and pads 626A-626B. Applicants cannot find any of these features in the reference.

None of the plated through-holes 10 are shown as being blind, i.e., open only at one end, nor can applicant find any feature bearing the reference numeral 626. Claim 16 is allowable over Markovich.

Claim 17

Claim 17 recites the “connector of claim 14 wherein the means for increasing flexibility comprises a thinning of the flexible substrate in the contact region, relative to a thickness of the substrate outside the contact region.”

Markovich also fails to teach this limitation. Even if the distortion of the substrate 14 at PTH 10 illustrated in Markovich’s Figures 4b and 5b could be considered analogous to a thinning of the substrate, which applicants dispute, Markovich specifically teaches moving this distortion as far away from individual BGA pads 12 as possible, by moving the holes to a central point between pads. For example Markovich states, starting at column 5, line 45:

[T]he closer the proximity between the PTH and the pad as measured, the higher is the plastic strain in the organic laminate chip carrier 14.

“Accordingly, by optimizing the spacings between the plated through-holes (PTHs) 10 and the BGA pads 12 so as to provide a more uniformly arrayed distribution or distances therebetween, there is obtained a reduction in thermal stress peaks in comparison with previously more closely spaced BGA pads and PTHS....

It is clear from this text that Markovich teaches distancing the PTH, and the resulting distortion, as far from the pads as possible, and thus, even if the distortions are considered thinning, teaches away from a thinning of the flexible substrate in the contact region, relative to a thickness of the substrate outside the contact region. Claim 17 is clearly allowable over Markovich.

Conclusion of Rejections Under 35 U.S.C. § 102

The Examiner has erred in asserting that Markovich teaches each of the claimed limitations of claims 1, 2, 4, and 6-20 as interpreted by one of ordinary skill in the art. The Examiner has erred in asserting that Markovich teaches a flexible substrate. The Examiner has erred in asserting that the plated through holes of Markovich are analogous to a strain relief structure. The Examiner has erred in asserting that Markovich teaches a strain relief structure

comprising a thinned region of a flexible substrate. The Examiner has erred in asserting that Markovich teaches a strain relief structure positioned such that it interrupts one of a plurality of electrical traces. The Examiner has erred in asserting that Markovich teaches a means for increasing flexibility of a substrate. For at least these reasons, the Examiner has failed to present a *prima facie* case of anticipation of claims 1, 2, 4, and 6-8.

Rejections Under 35 U.S.C. § 103(a)

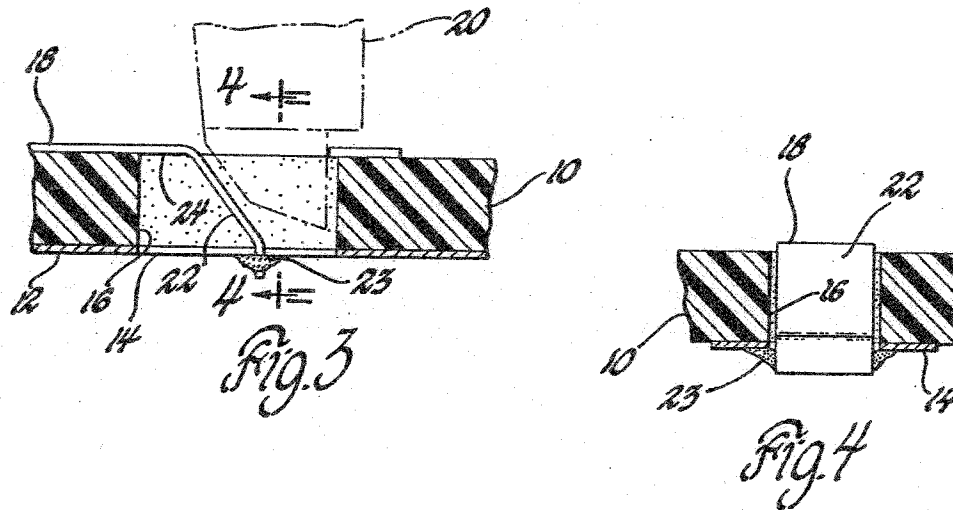
Claims 3 and 5

Claims 3 and 5 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,291,776 to et al. in view of U.S. Patent No. 3,977,074 to Furnival. Applicants believe the Examiner did not meet his burden to present a *prima facie* case of obviousness.

Furnival does not show, and is not cited by the Examiner as showing, the missing feature of a strain relief structure between contact pads. Furnival does not show contact pads or any apertures between them and thus does not teach this feature. Furnival is directed to a circuit board, rather than a connector, and further teaches away from a flexible substrate. Even if combined, Markovick and Furnival fail to show the claimed invention.

The Examiner asserted that “it would have been obvious to one having ordinary skill in the art at the time the invention was made to use a rectangular shape as taught by Furnival to employ the device of Markovich in order to improve more spaces, which is inexpensive and more reliable, for an interfacial connection.” This is a conclusory statement for which the Examiner offers no support. There is no evidence offered demonstrating that Furnival’s method is less expensive, more reliable, or would “improve more spaces.” Applicant notes that Furnival issued about twenty-two years before Markovich was filed, and thus must have been well known at the time. If the Furnival actually provided such advantages, why did Markovich fail to adopt them?

Furnival teaches “a printed circuit substrate 10 preferably of the rigid variety” (See column 2, lines 1, 2 of Furnival).



As shown in Furnival's Figure 3, Furnival is directed to a technology in which a hole is formed in a rigid substrate 10 having a conductive layer 12 on one surface. A second conductive layer 18 is then applied to the opposite surface of the substrate 10, and a piercing tool 20 is employed to form a tab 22, which is forced through the hole and soldered on two edges to the conductive layer 12 on the opposite side (column 2, lines 28). Viewing Furnival's Figures 3 and 4, it may be seen that the solder joint 23 is limited to a very short, narrow region on the edges of the tab 22. Accordingly, it would be obvious to one having ordinary skill in the art that such a connection would be inappropriate for use on a flexible connector, as the term is understood in the art, inasmuch as the flexing of the connector would tend to break the solder joints 23. Any twisting or flexing of the substrate would almost certainly cause such a connection to fail.

Thus, if the Examiner is correct in asserting that Markovich teaches a flexible substrate, which the applicants dispute, a combination with Furnival would render Markovich unsatisfactory for its intended use, in which case, the combination is inappropriate. On the other hand, if the applicants are correct in their belief that Markovich does not teach a flexible substrate, then the combination would teach away from a flexible substrate, and would therefore fail to teach or suggest all the limitations of the claims.

Conclusion of Rejections Under 35 U.S.C. § 103

Applicants believe that the Examiner has not met his burden of presenting a *prima facie* case of obviousness. The references are either inappropriately combined, or the combination

teaches away from the claimed invention. Furthermore, the cited references do not teach or suggest each limitation of the present invention, either individually or in combination.

In summary, applicants believe that the claims of the present invention are patentable, and not obvious in light of the references cited by the Examiner. Allowance of the claims is respectfully requested.

VIII. APPENDIX OF CLAIMS INVOLVED IN THE APPEAL

1. (Previously Presented) A device configured to electrically connect first and second circuit boards, comprising:

a flexible substrate;

a plurality of contact pads on a first surface of the substrate configured to make electrical contact with contact pads of the first circuit board; and

a strain relief structure, positioned between two of the plurality of contact pads.

2. (Original) The device of claim 1 wherein the strain relief structure is an aperture, penetrating through the flexible substrate from the first surface to a second surface.

3. (Original) The device of claim 2 wherein the aperture has, in plan view, a rectangular shape.

4. (Original) The device of claim 1, wherein the strain relief structure is a thinned region of the flexible substrate.

5. (Original) The device of claim 4, wherein the thinned region has, in plan view, a rectangular shape.

6. (Original) The device of claim 1, wherein the strain relief structure is centered on a line between centers of two of the plurality of contact pads.

7. (Previously Presented) The device of claim 1, further comprising a plurality of electrical traces, each of the plurality of electrical traces being in electrical contact with a respective one of the plurality of contact pads and configured to place the respective contact pad in electrical contact with the second circuit board.

8. (Previously Presented) The device of claim 7, wherein the strain relief structure is positioned such that it electrically interrupts one of the plurality of electrical traces.

9. (Previously Presented) A first electrical connector, comprising:
a flexible substrate;
a plurality of contact pads arranged in a regular configuration on a first surface of the substrate;
a plurality of electrical traces on the flexible substrate, each of the plurality of electrical traces being in electrical contact with a respective one of the plurality of contact pads and configured to provide electrical coupling with a second electrical connector; and
a plurality of apertures penetrating through the flexible substrate, the plurality of apertures arranged in a regular configuration and intercalated into the plurality of contact pads.

10. (Previously Presented) A method of manufacturing a flexible connector, comprising:
forming, on a first surface of a flexible substrate, a plurality of contact pads;

forming, on the flexible substrate, a plurality of electrical traces, each of the plurality of electrical traces being in contact with a respective one of the plurality of contact pads, at least one of the plurality of electrical traces being configured to place the respective one of the plurality of contact pads in electrical contact with an additional connector; and

forming, between two of the plurality of contact pads, a strain relief structure.

11. (Original) The method of claim 10, further including breaking one of the electrical traces with the forming the strain relief structure step.

12. (Original) The method of claim 10 wherein the strain relief structure is an aperture penetrating the flexible substrate from the first surface to a second surface.

13. (Original) The method of claim 10, wherein each of the plurality of electrical traces is formed on either the first surface of the flexible substrate, a second surface of the substrate or an inner layer of the substrate.

14. (Previously Presented) A flexible connector for placing first and second circuit boards in electrical contact, comprising:

a flexible substrate;

a plurality of contact pads formed on a first surface of the substrate and arranged in a regular configuration in a contact region of the flexible connector; and

means for increasing flexibility of the substrate in the contact region.

15. (Previously Presented) The connector of claim 14 wherein the means for increasing flexibility comprises a plurality of apertures intercalated with the plurality of contact pads and penetrating the flexible substrate from the first surface to a second surface, opposite the first.

16. (Previously Presented) The connector of claim 14 wherein the means for increasing flexibility comprises a plurality of blind apertures intercalated with the plurality of contact pads and penetrating the flexible substrate from the first surface to selected depth.

17. (Previously Presented) The connector of claim 14 wherein the means for increasing flexibility comprises a thinning of the flexible substrate in the contact region, relative to a thickness of the substrate outside the contact region.

18. (Previously Presented) The first electrical connector of claim 9 wherein each of the plurality of apertures is configured to increase flexibility of the substrate.

19. (Previously Presented) The first electrical connector of claim 9, further comprising an additional electrical trace on the flexible substrate in electrical contact with one of the plurality of contact pads, and wherein one of the plurality of apertures is positioned such that the additional electrical trace is electrically interrupted by the one of the plurality of apertures.

20. (Previously Presented) The first electrical connector of claim 9, further comprising an additional plurality of electrical traces on the flexible substrate, each of the additional plurality of electrical traces being in electrical contact with at least a respective one of

the plurality of contact pads, and wherein ones of the plurality of apertures are positioned such that each of the additional electrical traces is electrically interrupted by a respective one of the plurality of apertures.

21. (Previously Presented) The method of claim 13 wherein at least one of the plurality of electrical traces is formed on the inner layer of the substrate.

IX. Evidence appendix

The attached declaration was filed under Rule 37 CFR 1.131 with the applicants' amendment of September 15, 2004 to swear behind U.S. Patent No. 6,595,784 to Brodsky et al., which reference was cited by Examiner Dinh in a rejection issued in the Office Action of June 7, 2004.

X. Related Proceedings Appendix

None.

Respectfully submitted,
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